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ABSTRACT

A two-phase study about skilled memory as it is used by waitresses included a participant-observer phase and an observational phase. Participants were three experienced waitresses who had worked at a midtown Manhattan restaurant for 14, 7, and 3 years respectively and a team of 5 confederate customers. Waitresses and customers wore microphones. Customers ordered a lunch consisting of a sandwich, dessert, and beverage. Tapes from four observations taken on separate days for each waitress were transcribed and analyzed. Written checks were also collected and analyzed. Working under the speed contraint of their job, the waitresses were very accurate. Although all orders were given in the form sandwich, dessert, beverage, not only were sandwiches and beverages pulled from a list of 15 items and handled toqether or first, but different kinds of sandwiches and beverages (hot or cold) were clustered together. Desserts were also clustered and were always the last items served. Waitresses appeared to use a double classification system: type of item, subclassified by food location. Information was organized in different ways and was multiply encoded by the waitresses, who anticipated different uses for it at different points in their flow of activity. (Four figures and two tables are attached.) (YLB)

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AN OBSERVATIONAL STUDY OF SKILLED MEMORY IN WAITRESSES

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This study is about skilled memory as it is used by waitresses on the job, as they go about remembering lunch orders. The ways in which waitresses use their memories at work suggests that the laboratory derived model of skilled memory can usefully be expanded.

Chase and Ericsson (1981) based their model of skilled memory on the performance of a subject, who, after lengthy practice, was able to increase his digit span from 8 to 84 digits. The subject was a runner, and had a well learned body of information about running times at his disposal. He encoded the digits as running times. Through practice, hypothesized Chase and Ericsson, temporary knowledge structures consisting of skillfully encoded familiar information were built up in long term memory. The skill lay in the encoding. By anticipating future uses for the information being stored, the encoder builds in retrieval cues which allow for subsequent rapid access of the information in the temporary knowledge structures. Since these structures are in long term memory, any capacity limitations of short term storage are bypassed. Chase and Ericsson found that encoding became more rapid with practice, but the major feature of skilled memory in this model is increased capacity.

The model was subsequently applied to cocktail waitresses in a study by Bennett (1983), who found that the waitresses were able to remember large numbers of drink orders without writing them down. The encoding strategy used by the waitresses was similar to the method of loci; that is, drinks were associated in memory with the customer who ordered them. Instead of moving through remembered or imagined space, however, the waitresses moved through real physical space as they went back and forth to the customers tables. Presumably, well learned knowledge about the physical layout of the bar and various drinks provided the basis for their encoding. The focus in this study was on the number of drinks remembered and served to the correct customers;

that is, the capacity of the waitresses' memories. Bennett also reported, however, what he said was another process; that is, the waitresses, while calling drinks to the bartender, sorted them into the bartender's calling order, according to drink ingredients.

A focus on increased capacity alone does not take into account any effect which real world task demands may have on the organization of the to be recalled items. In this paper, I will argue that waitresses on the job use their memories in adaptive, goal directed ways. Skilled memory for them includes the ability to retrieve information in different ways at different times. Therefore my focus will not be on the capacities of waitresses' memories, but on how meal items are organized at different points in the flow of their overall activity.

I conducted a two phase observational study of waitresses in a midtown Manhattan restaurant during the lunch hour shift. During the first phase I worked as a waitress myself for three months. As a participant observer, I learned about the job by doing it, and by informally observing other waitresses. This provided the basis for a second more systematic set of observations, which I will report today. First I will give a description of waitressing and the setting in which it was observed. Then I will report my method of observation and my findings. Following Bartlett's (1958) characterization of human skill as possessing "the outstanding characteristic of rapid adaptation", I will show that memory as it is used by waitresses on the job reveals this characteristic.

From a customer's perspective, waitressing has a basic sequence in which the waitress takes an order, obtains the items in the order, serves them, and collects payment. The order itself has its own sequence, in which, for example, a dessert is not served before a sandwich. From the point of view of the waitress, however, a customer-oriented sequence is not especially

useful. She must meet explicit speed and accuracy requirements both to keep her job and to get good tips; and her flow of activity must adapt itself to meet these requirements.

In the restaurant used in this study, waitresses work at U shaped counters which seat 12 or more people. Customers sit at the counter, singly or in groups, as space becomes available. At any one moment, 12 customers may be at different stages of eating their lunch; some may have just ordered, some may be sitting down, some may be finishing up. The counters are at varying distances from the kitchen (see figure 1), which is divided into a hot and a cold section. At any one moment, food items which have been ordered by the waitress from one or both sections may be at different stages of preparation; and the preparation time can vary depending on the food item itself or the busyness of the kitchen. Waitresses call orders for sandwiches and entrees to the kitchen. The kitchen prepares them and puts them on a shelf, from which the waitress picks them up and serves them. The waitress also picks up beverages and desserts from other locations and serves them (see figure 1). As a matter of procedure in this restaurant, waitresses write checks as they take orders; but then, instead of carrying the checks with them, they leave them on the counter in front of the customer, and, relying on their memories, go to call or pick up items. Since waitresses serve not one, but twelve customers, it is useful to save trips by ordering and picking up more than one item at once. Speed requires coordination of actions, and therefore some consolidation of order items in memory in order to do this.

The use of memory by these waitresses differs from laboratory recall tasks in several ways. Instead of visually or auditorily presented words, phrases, or digits administered at a controlled rate, say, every 3 seconds, orders are given by customers at varying rates of speed, often prompted by such questions from the waitress as "And what would you like to drink?" In the

laboratory a set number of items are given in an often uninterrupted linear sequence. Recall may proceed at the subject's pace and is also uninterrupted. Waitresses' recall on the job, however, is both interrupted and non linear. For example, she may take several orders and start off to the kitchen to call them, but pause on the way to serve a beverage. While the kitchen is preparing items, she cannot simply stand and wait for them. To satisfy the speed requirement of her job, she must either pick up and serve other items, or return to her counter and take other orders. At the same time, she must monitor the kitchen area to see when sandwiches and entrees are ready, since if someone waits too long for a sandwich, or if a hot item gets cold, tips will be reduced. When they are ready, she loops back to the kitchen to pick them up, serves them, and proceeds to handle other items. Her recall occurs in series of loops as she travels back and forth between the counter and other locations; one set of to be remembered items is often interspersed with other sets of items, and speed is always a necessity.

The input of the to be remembered items provides additional differences from laboratory studies. As the waitress takes the orders, she writes them down. Moreover, these written checks are available on the counter as external cues, should she wish to use them. In trips to and from the counter, things like empty sandwich plates may serve as reminders of desserts. One aspect of waitresses' recall resembles laboratory situations, and that is when they leave the counter, relying on their memories, to call or pick up sets of items. But the overall flow of activity includes many sets of items along with the possibility of some of the items being re-inputted with returns to the counter from other locations. This job description shows that serving orders to customers is only one part of how waitresses use their memories. A focus on the capacities of waitresses' memories, using the number of orders correctly served to customers as evidence of capacity, will not capture the

way memory is used in the overall sequence of activity. I will mention one final difference between the laboratory and the restaurant. In a situation where the number of items recalled counts as data, full recall is seldom expected. Waitresses, however, must serve to every customer all the items which they have ordered.

In order to obtain information about the waitresses' entire sequence of activity, I designed a procedure which would capture events both at the counter and away from the counter. Three experienced waitresses agreed to participate. They had worked at this restaurant for 14, 7, and 3 years respectively, and the manager described them as skilled. This meant that they could handle large numbers of customers during peak hours with a minimum number of mistakes. Each waitress agreed to wear a wireless microphone, so whatever she said while away from the counter could be recorded. A team of five confederate customers came to the restaurant after the busiest part of the lunch hour had subsided, and, wearing lapel microphones, took adjoining seats at the counter of a participating waitress. Each confederate ordered a lunch consisting of a sandwich, a dessert, and a beverage. Customer checks had been collected from two counters over a two day period, and it was found that the majority of orders were written in the form of sandwich, followed by dessert, followed by beverage. This, therefore, was the sequence followed by the confederate customers as they gave their orders. Each confederate noted into his or her microphone when his or her individual sandwich, dessert, or beverage was picked up and served. Mistakes made by the waitress were also noted.

Five orders of 3 items each formed a recall list of 15 items. Hot and cold items were alternated in order to see if they would be reorganized, and if so, how. So, each set of 15 items included 3 hot and 2 cold sandwiches, (alternating), 5 desserts, and 3 cold and 2 hot beverages; arranged in clusters of 3 according to customer. Therefore, the sequence of activity observed in this

study was that of a waitress handling orders for a group of 5 people. It included taking the orders, calling them to the kitchen, and picking up and serving sandwiches, desserts and beverages. Four observations were taken on separate days for each of the three waitresses. The tapes from these observations were transcribed and analyzed, and the written checks were also collected and analyzed.

First I will report data on the waitresses' accuracy, then I will report some interesting features of the written checks, then I will report the way in which order items were organized at different points in the waitresses' activity.

Table 1 shows the number of errors made by each waitress. There are three possible types of errors. First, a waitress could entirely neglect to serve an item. This did not occur at all for any waitress. Second, an item could be handled incorrectly; for example, a sandwich could be served on the wrong kind of bread. Of the 180 items handled by all three waitresses in all four observations, this kind of error occurred 6 times. Third, an item could be served to the wrong customer. This occurred three times, and one waitress accounted for all three occurrances. The errors involved beverages and a dessert; and in no instance did a waitress serve a sandwich to a wrong customer. Working under the speed constraint of their job, these waitresses were very accurate.

The speed constraint of the job is reflected in the fact that as waitresses took orders and wrote them down, they wrote them in abbreviated form. None of the 60 checks contained the name of any sandwich or dessert written out in full. Beverages such as tea or tab were sometimes written out, but coke and coffee were not. Each waitress handled 3 orders for coffee, and in every case, it was abbreviated with a C. The waitresses received between 2 and 4 orders for coke, and in every case, it was abbreviated with a K. Of the 60 abbreviated sandwiches, 29 reflected the use of a standardized restaurant code used by the waitresses when calling items to the kitchen. Figure 2 shows that not all menu

items are included in this code, but for those which are, the code shortens the time it takes to call the item, and helps to prevent time consuming misunderstandings by the kitchen. So, these written checks reveal that at the same time the orders were taken by the waitresses, they were not only written down, but they were abbreviated and sometimes encoded in ways that would save time and minimize mistakes.

Now I will report the way in which items were organized in the waitresses' recall. Figure 3 shows data from one of the waitress's transcripts which is typical of all 12 observations. To the left are the items as they were ordered by customers. To the right are the items listed in the sequence in which the waitress acted on the items. Calling the items to the kitchen was recorded via the waitresses' wireless microphones, and was the first action on the sandwiches. Picking up and serving beverages, sandwiches, and desserts was recorded by the confederate customers into their lapel microphones. The second appearance of sandwiches in the sequence to the right in figure 3 shows where they were picked up and served.

These data reveal that although all of the orders were given in the form sandwich, dessert, beverage, there was not one case of a beverage being the last item handled. In 5 out of 12 observations, beverages were handled (as in figure 3) either before or after calling items to the kitchen. In the remaining 7 observations, beverages were handled either right after calling items to the kitchen, or else some were handled after calling sandwiches and some were interspersed with serving sandwiches. In addition, in all 12 observations, when sandwiches were called to the kitchen, they were sorted into hot and cold items. So that, not only were sandwiches and beverages pulled from a list of 15 items and handled together or first, but different kinds of sandwiches and beverages were clustered together. Desserts were also clustered, and although they were always the second items ordered, they were always the last items to be served.

Bousfield and Bousfield's (1966) relative ratio of repetition, which measures the amount of clustering in free recall of members of non overlapping categories, was used to analyze the waitresses' sequences of action. (See figure 4) Lists were compiled of the first action with each item after taking the order; that is, calling sandwiches to the kitchen, and picking up and serving beverages and desserts. Sandwich pick up, which depended on kitchen preparation time, and which was the second action with the sandwiches, is not included in this next analysis. Figure 4 shows a retrieval sequence along with 3 possible sets of categories each item could belong to. The relative ratio of repetition is obtained by comparing the number of stimulus category repetitions which occur in recall with the number which may be expected to occur by chance. So, if "sandwiches" is a category, and a waitress handles 5 sandwiches in a row, this would be 4 stimulus category repetitions, or SCRs.

Three possible sets of categories, or organizational schemes, were used to look at clustering. One retrieval scheme might be organization by customer. Other studies, for example Bennett (1983) and Ericsson and Polson (1984) have shown that waiters and waitresses use variations of the method of loci for obtaining and serving customer orders. Items are associated in mental images with the customer who ordered tham and/or the location of the customer. It seemed reasonable to suppose then, that customers as categories might be reflected in the retrieval sequence. Another organizational scheme might be food categories, since the checks were written in the form of sandwich, dessert, beverage. A third possibility, since sandwiches were sorted into hot and cold items, might be locational categories in the restaurant. Table 2 shows the observed SCRs and RRRs for these organizational schemes.

When "customer" was used as an organizing principle, the mean RRR was .17, which means the number of SCRs were .17 of what one would expect by chance. In 9 out of 12 observations, there was not one SCR. The waitresses'

retrieval sequences did not reflect the use of customers as organizing categories. This is interesting, since all of the items were eventually served to the people who ordered them, and we will discuss this question later. In comparison, the RRR for type of food item was 2.91, almost three times what one would expect by chance. Finally, if we look at retrieval sequences as organized by location, we see that the overall mean RRR is 4.36, the highest clustering score of the three alternatives tested. This reflects the fact that after the waitresses took the orders, sandwiches were not only pulled out and handled together, but were sorted into hot and cold. The waitresses appeared to be using a double classification system; type of item, subclassified by food location, such as hot kitchen or cold kitchen. Beverages were clustered according to whether they were obtained at the counter or the cold soda machine. Desserts were clustered according to whether they came from a dessert case or area near the kitchen, or a separate cake and pie case near the counters.

Researchers such as Chi and Koeske (1983) and Rabinowitz and Mandler (1983) have used Bousfield and Bousfield's measures of clustering as evidence of links between items in either a semantic network or a schematic or taxonomic organization of information inside the head of the rememberer. "More and better structures knowledge", said Chi and Koeske, are necessary for improved memory performance. By better structured, they meant more links between items in a semantic network. Such links, they hypothesized, are formed by repeated exposure. This characterization of an internal knowledge structure resembles the well learned body of information on running times Chase and Ericsson's subject used to encode digits. The emphasis is on organization inside the head. The waitresses in this study, however, are organizing information in a restaurant which has its own organization. At the same time, they are dealing with constantly changing configurations of customers, which means constantly changing configurations of order items at the counter, at the kitchen, at the soda machine, and at the dessert cases. This study suggests that clus-

tering can also be interpreted as links between the person and the context in which she is working, in the form of adaptive organizations of information.

If this is so, why would customers as categories not be reflected as clustering in the retrieval sequences? In order to answer this, I will briefly review what the waitresses are doing. There are really three tasks which memory must perform if customers are to be served quickly and accurately. First, the correct order items must be obtained. This includes calling items to the kitchen and picking up desserts and beverages. The second task is to monitor the kitchen so that items can be picked up when they are ready. As I mentioned before, in the interest of speed, it is important to monitor the kitchen in such a way that attention can be allocated to other activities, such as serving beverages. Perhaps this resembles the "strategic time monitoring" Ceci and Bronfenbrenner (1985) talk about in their study of prospective memory. The third task for memory is to allow the correct items to be served to the customers who have ordered them. The configurations of information held in memory for each of these tasks may be different. This study shows that order items were given to the waitress in one sequence, organized by customer. This organization was not reflected in calling sandwiches to the kitchen or in picking up desserts and beverages. Instead, items were clustered into locational categories. Customers as categories were not relevant for the task at hand at this stage of handling the orders. This locational information, however, was not relevant when it came to serving the items. The fact that only 3 out of 180 items were served to the wrong customers indicates that it was not used. Memory, for these waitresses, did what it had to do. But how? The fact is that the waitresses acted upon order items in different configurations at different times. This could mean that information was organized in different ways, and was multiply encoded by the waitresses; who, being skilled at their job, anticipated different uses for the information at different points in their flow of activity.

According to Singleton (1978), different actions in a skilled activity gain coherence from their underlying goal. The objective provides the activity with both meaning and direction. So, the ability to combine actions into organized, directed patterns is a characteristic of skill, and, says Singleton, "one thing for a skilled man may be half a dozen things for an unskilled man". As the waitresses wrote checks, they were simultaneously taking orders and anticipating future payment. Their abbreviations also reflect the job's speed and accuracy requirements. Might they also have been sorting items by location as they wrote them down by customer? Remember also that after calling orders to the hot and cold kitchen, the waitresses, in 10 out of 12 observations, immediately picked up cold drinks from the machine near the cold kitchen.These actions were uncontaminated by any additional re-inputting of information from returns to the counter. Whatever form of encoding was used, it allowed not only for different configurations of individual items, but it also included a change in sequence, from the sandwich, dessert, beverage in the order to sandwiches, followed by beverages, or in some cases, beverages, sandwiches, then again, beverages.

Whether the waitresses selectively move back and forth between different forms of encoding, or access one form of encoding in different ways, cannot be resolved by this observational study. Nevertheless, this data presents a picture of the organization and retrieval of information in a system which is fluid and dynamic rather than fixed and static. The system includes not only the waitress and what is inside her head, but changing as well as stable features of the context in which she is working. Skilled memory, besides providing links between short term and long term memory to allow for rapid access and increased capacity, can also be thought of as providing adaptive organizations of information; and therefore links between what is inside of and outside of the head.

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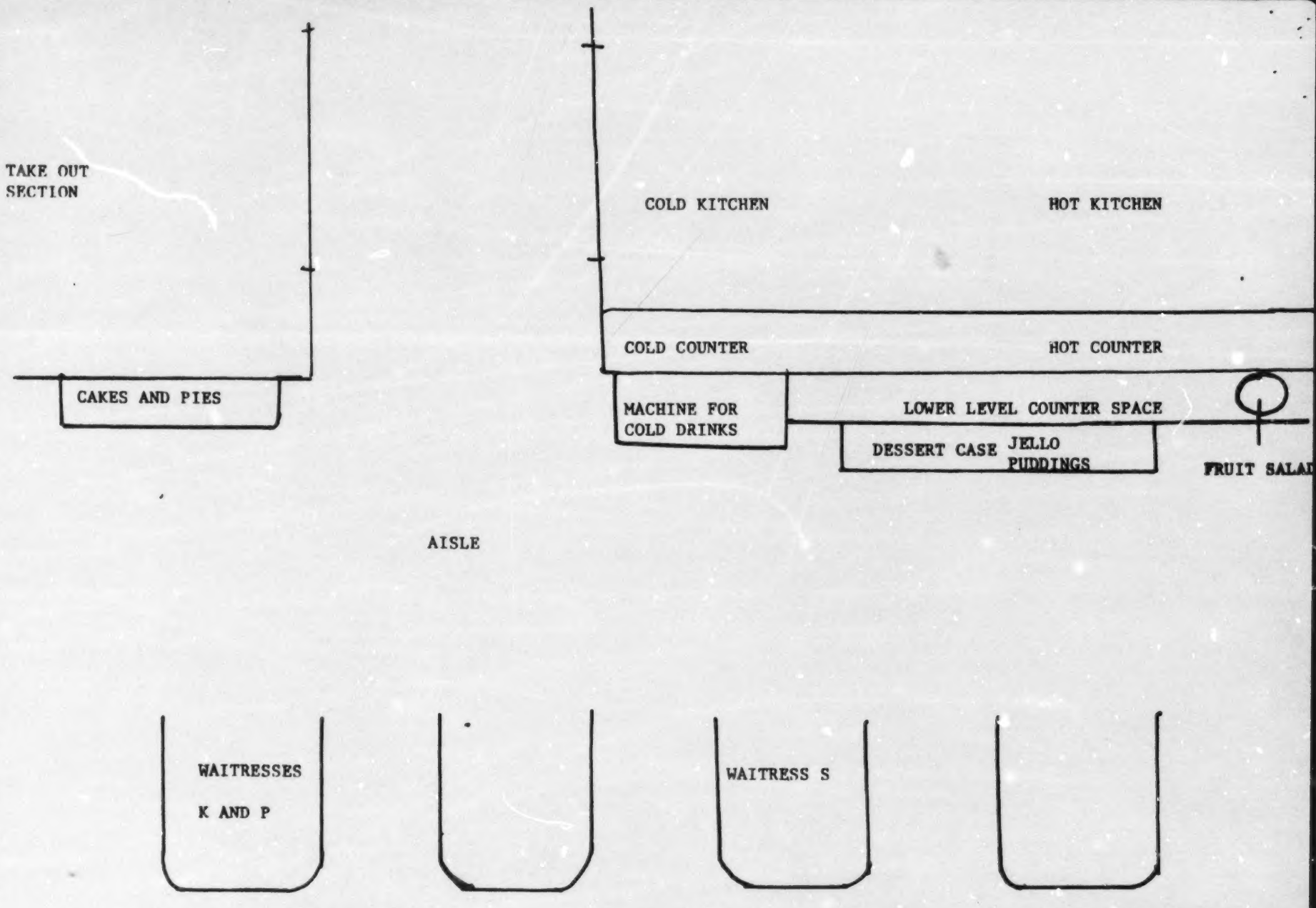
TAKE OUT
SECTION
CAKES AND PIES
COLD KITCHEN
HOT KITCHEN
COLD COUNTER
HOT COUNTER
MACHINE FOR
COLD DRINKS
LOWER LEVEL COUNTER SPACE
DESSERT CASE
JELLO
PUDDINGS
FRUIT SALA
AISLE
WAITRESSES
K AND P
WAITRESS S

FIGURE 1

FIGURE 2

KITCHEN CODES AND ABBREVIATIONS

NAME OF SANDWICH, # OF ORDERS	KITCHEN CODE OR KITCHEN ABBREVIATION	WAITRESSES' ABBREVIATION
EGG SALAD (8)	EGG	EGG OR EG
GRILLED CHEESE (9)	JACK	J OR JAC
GRILLED CHEESE WITH BACON (8)	JACK BACK	JB OR JAC BAC
HAM AND CHEESE (1)	COMBO	COMBO
CREAM CHEESE WITH CHIVES ON BLACK BREAD (3)	CC BLACK	CCB
TURKEY AND METTWURST (5)	TURKEY	TUR OR TURKEY
CHICKEN SALAD	CHICKEN	CH
TUNAFISH SALAD	TUNA	TUNA
HAMBURGER	BURGER	H OR # OR BURGER
CHOPPED LIVER (3)	—	CL OR CHOP
CHEESEBURGER (11)	—	CB, OR CHEEB

FIGURE 3

INPUT: TAKING THE ORDERS	OUTPUT: OBTAINING THE ITEMS	
CHEESEBURGER	TEA	PICK UP AND SERVE
FRUIT SALAD	COFFEE	PICK UP AND SERVE
TAB		
	BURGER	CALLS TO THE KITCHEN
EGG SALAD	CHEESEBURGER	CALLS TO KITCHEN
JELLO	JACK	CALLS TO KITCHEN
TEA		
	EGG	CALLS TO KITCHEN
GRILLED CHEESE	CHOPPED LIVER	CALLS TO KITCHEN
APPLE CRUMB CAKE		
SPRITE	TAB	PICK UP AND SERVE
	SPRITE	PICK UP AND SERVE
CHOPPED LIVER	COKE	PICK UP AND SERVE
RICE PUDDING		
COFFEE	CHEESEBURGER	PICK UP AND SERVE
	CHOPPED LIVER	PICK UP AND SERVE
HAMBURGER	EGG SALAD	PICK UP AND SERVE
CHOCOLATE PUDDING	HAMBURGER	PICK UP AND SERVE
COKE	GRILLED CHEESE	PICK UP AND SERVE
	APPLE CRUMB CAKE	PICK UP AND SERVE
	FRUIT SALAD	PICK UP AND SERVE
	JELLO	PICK UP AND SERVE
	CHOCOLATE PUDDING	PICK UP AND SERVE
	RICE PUDDING	PICK UP AND SERVE

FIGURE 4

POSSIBLE CATEGORY MEMBERSHIP FOR RETRIEVED ITEMS (WAITRESS S.)

ORDERS:

GRILLED CHEESE
CHEESECAKE
BIRCH BEER

TURKEY AND METTWURST
FRUIT SALAD
TEA

GRILLED CHEESE WITH BACON
JELLO
TAB

CHOPPED LIVER
CHOCOLATE PUDDING
COFFEE

CHEESEBURGER
RICE PUDDING
SPRITE

RETRIEVAL SEQUENCE	CUSTOMER # 1,2,3,4,5	SANDWICH =1 DESSERT = 2 BEVERAGE= 3	LOCATIONS (6)
CHOPPED LIVER	4	1	COLD KITCHEN
TURKEY AND METTWURST	2	1	COLD KITCHEN
CHEESEBURGER	5	1	HOT KITCHEN
GRILLED CHEESE	1	1	HOT KITCHEN
GRILLED CHEESE WITH BACON	3	1	HOT KITCHEN
SPRITE	5	3	COLD MACHINE
BIRCH BEER	1	3	COLD MACHINE
TAB	3	3	COLD MACHINE
TEA	2	3	COUNTER
COFFEE	4	3	COUNTER
CHEESECAKE	1	2	CAKE/PIE CASE
JELLO	3	2	KITCHEN AREA
FRUIT SALAD	2	2	KITCHEN AREA
CHOCOLATE PUDDING	4	2	KITCHEN AREA
RICE PUDDING	5	2	KITCHEN AREA

TABLE 1

NUMBER OF ERRORS

		ITEM FORGOTTEN	ITEM INCORRECT	ITEM SERVED TO WRONG PERSON
WAITRESS S				
OBSERVATION	1.	0	PUT WHIPPED CREAM ON DESSERT WHEN ORDER SAID NONE	1 BEVERAGE
	2.	0	0	1 BEVERAGE 1 DESSERT (1 SANDWICH SELF CORRECTED BEFORE ACTUALLY SERVED)
	3.	0	PICKED UP EXTRA DESSERT	0
	4.	0	0	0
TOTAL ERRORS: 5		0	2	3
WAITRESS K	1.	0	0	0
	2.	0	0	0
	3.	0	ORDERED RYE INSTEAD OF BLACK BREAD	0
	4.	0	0	0
TOTAL ERRORS: 1		0	1	0
WAITRESS P	1.	0	KITCHEN ERROR, WRONG BREAD, NOT CAUGHT	0
	2.	0	NO LEMON WITH TAB	0
	3.	0	0	0
	4.	0	PUT WHIPPED CREAM ON DESSERT WITHOUT ASKING	0
TOTAL ERRORS: 3		0	3	0

TABLE 2

OBSERVED AND EXPECTED SCRS, AND RELATIVE RATIOS OF REPETITION

	CUSTOMERS(5)		MEAL ITEMS(3)		LOCATIONS(6)	
# SCRs EXPECTED BY CHANCE:	2		4		1.60 to 1.87	
	OBSERVED	RATIO	OBSERVED	RATIO	OBSERVED	RATIO
WAITRESS K						
OBSERVATION 1.	1	.50	10	2.50	8	4.28
2.	0	0	11	2.75	8	4.28
3.	0	0	11	2.75	9	4.80
4.	0	0	12	3.00	9	4.80
MEAN RRR:		.13		2.85		4.54
WAITRESS S.						
OBSERVATION 1.	0	0	12	3.00	8	4.62
2.	0	0	12	3.00	7	4.38
3.	0	0	12	3.00	9	4.80
4.	0	0	12	3.00	7	4.38
MEAN RRR:		0		3.00		4.55
WAITRESS P.						
OBSERVATION 1.	1	.50	10	2.50	5	3.13
2.	0	0	12	3.00	9	4.80
3.	2	1.00	12	3.00	8	3.76
4.	0	0	12	3.00	8	4.28
MEAN RRR:		.38		2.88		3.99
OVERALL MEAN RRRs:		. 17		2.91		4.36